Pathologic Features of COVID-19 Associated Myocardial Injury:

A Multicenter Cardiovascular Pathology Study

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SUPPLEMENTARY MATERIAL

Supplementary Table 1: Presentations and Causes of Death

Initial Clinical Presentation	Number of Patients	Mechanism of Death
Fever, Dyspnea, and Cough	9	ARDS (n=5) Viral pneumonia (n=3) Cardiogenic shock (n=1)
Fever and Dyspnea	6	ARDS (n=6)
Dyspnea / Respiratory Failure	2	ARDS (n=1) Cardiac Arrest (n=1)
Fever, Cough, and Anosmia	1	ARDS
Fever and Sore Throat	1	ARDS
Fever	1	ARDS
Altered Mental Status and Respiratory Failure	1	Viral Pneumonia

Supplementary Table 2: Selected Laboratory Values at Time of Peak Troponin

	All Cases	Without Myocarditis	With Myocarditis	P
N	16	13	3	
eGFR (mL/min/1.73m^2)	30 (11-110), n=11	47 (11-110), n=9	40 (13-66), n=2	ND
Creatinine (mg/dL)	1.64 (0.49-4.99)	1.66 (0.49-4.99)	1.16 (0.97-4.45)	1.00
ALT (U/L)	43 (12-280), n=14	43 (20-280), n=12	64 (12-115), n=2	ND
AST (U/L)	116 (24-1180), n=14	100 (24-1180), n=12	121 (110-131), n=2	ND
WBC (10^3 cells/μL)	15 (2-40)	15 (3-40)	21 (2-22)	0.70
Neutrophils (10^3 cells/μL)	14 (2-29)	14 (2-29)	16 (2-19)	0.80
Lymphocytes (10^3 cells/μL)	0.6 (0.1-4.8), n=15	0.6 (0.1-3.8), n=12	1.3 (0.5-4.8), n=3	0.28
Monocytes (10^3 cells/μL)	0.5 (0.1-3.6), n=16	0.5 (0.1-3.6), n=12	0.4 (0.1-1.3), n=3	0.61
Eosinophils (10^3 cells/μL)	0.03 (0-2.6), n=14	0.03 (0-2.6), n=11	0.07 (0-1.1), n=3	0.81

Data are expressed as median (range). For variables not available for all 16 patients, the number of patients with the variable is indicated. P values represent comparison of patients with and without myocarditis. eGFR: estimated glomerular filtration rate; ALT: alanine aminotransferase; AST: aspartate aminotransferase; WBC: white blood cell count; ND: not determined since one group consisted of less than three values.

Supplementary Table 3: Initial and Final Laboratory Values For Patients with Troponin Measurements.

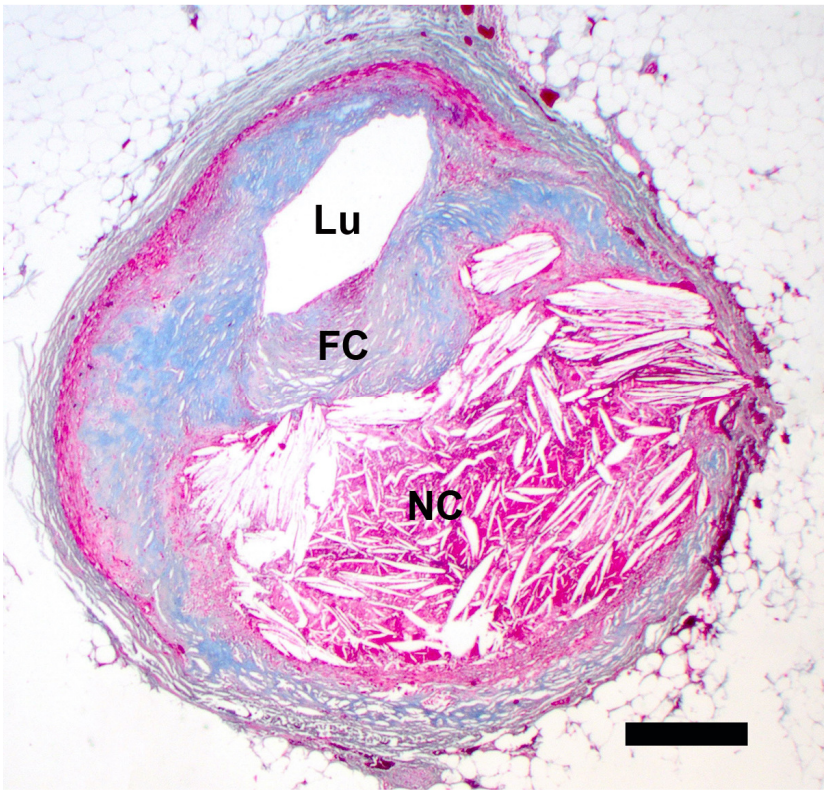
	Initial Measurement	Final Measurement	Number of Patients with Trending Value[a]
N	16	16	
eGFR (mL/min/1.73m^2)	67 (15-110), n=10	26 (11-95), n=11	8 (80)
Creatinine (mg/dL)	1.4 (0.5-5.0)	2.2 (0.4-5.0)	9 (56)
ALT (U/L)	52 (15-223), n=15	53 (12-366), n=15	8 (53)
AST (U/L)	65 (24-155), n=15	110 (15-1906), n=15	10 (67)
WBC (10^3 cells/μL)	10.5 (2.7-21.2)	15.9 (1.6-47.2)	10 (63)
Neutrophils (10^3 cells/μL)	8.9 (1.8-16.0), n=15	15.2 (1.2-41.0), n=15	10 (71)
Lymphocytes (10^3 cells/μL)	0.52 (0.09-4.81), n=13	1.14 (0.15-3.84), n=15	7 (58)
Monocytes (10^3 cells/μL)	0.43 (0.06-1.39), n=13	0.69 (0.03-3.60), n=15	6 (50)
Eosinophils (10^3 cells/μL)	0.01 (0-1.69), n=13	0.18 (0-3.23), n=15	8 (73)

Data are expressed as median (range). For variables not available for all 16 patients, the number of patients with the variable is indicated. eGFR: estimated glomerular filtration rate; ALT: alanine aminotransferase; AST: aspartate aminotransferase; WBC: white blood cell count.

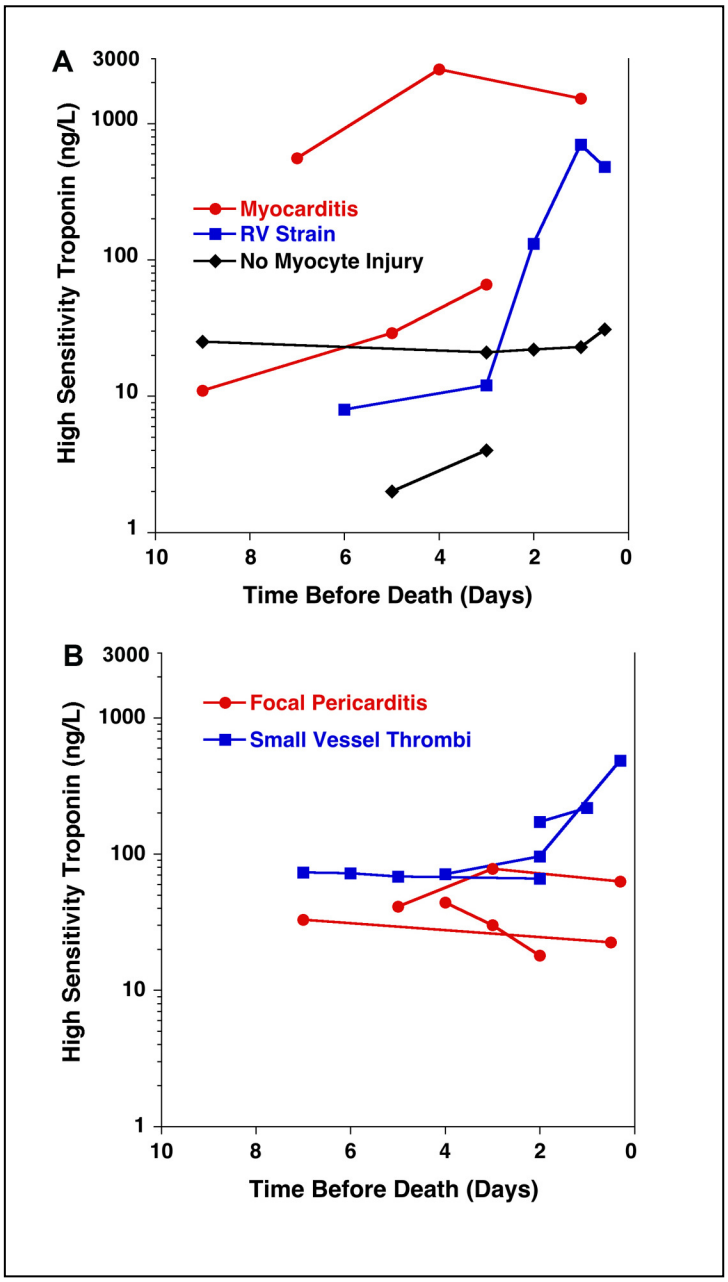
[a]Trending value: a decrease in eGFR, an increase for all other measurements, expressed n (% of the patients with both initial and final measurements).

Supplementary Table 4: Bedside Echocardiographic Findings in Five Patients Without Myocarditis and Without Pathologic Right Ventricular Strain Injury.

Patient	Echocardiographic Observations
A	No kinetic abnormalities Preserved left ventricular ejection fraction
B	No kinetic abnormalities Left ventricular ejection fraction 50%
C	Right ventricular hypertrophy and overload
D	Hyperdynamic left ventricle with ejection fraction 76% Left ventricular end-diastolic diameter 50mm Left ventricular end-systolic diameter 29mm No pericardial effusion or valvular insufficiencies
E	Hypokinetic right ventricle with moderate right ventricular systolic dysfunction Mild to moderate tricuspid regurgitation, mild mitral regurgitation Left ventricular ejection fraction 55% Left ventricular end-diastolic diameter 50mm No pericardial effusion



Supplementary Figure 1. Severe coronary artery stenosis. Histologic photograph depicting severe (>75%) coronary artery stenosis from atherosclerosis in one of the patients. Trichrome stain, scale bar represents 500 μM. Labelled are the residual lumen (Lu), fibrous cap (FC) and necrotic/lipid core (NC).



Supplementary Figure 2. Troponin curves for the different pathologic changes identified at autopsy. The troponin values were plotted versus the time interval before death for two patients with myocarditis (A, red circles), one patient with right ventricular strain injury (A, blue squares), three patients with focal pericarditis (B, red circles), three patients with small vessel thrombi (B, blue squares) and two patients with none of these changes (A, black diamonds).